TENNESSEE DEPARTMENT OF EDUCATION
FIRST TO THE TOP

Anatomy and Physiology

Primary Career Cluster:	Health Science
Consultant:	Amy F. Howell, (615) 532-2839, Amy.F.Howell@tn.gov
Course Code(s):	5991
Prerequisite(s):	Prerequisites: *Biology I* (3210) and *Health Science Education* (5998); Pre- or co-requisite: *Chemistry I* (3221)
Credit:	1-2 credits**
Grade Level:	11-12
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Health Science courses. It can also count as a science credit and is accepted by the NCAA as a science course.
Programs of Study and Sequence:	This is the third course in *Biotechnology Research, Diagnostic Services, Therapeutic Nursing Services,* and *Emergency Services* programs of study, and the fourth course in the *Therapeutic Clinical Services* program of study.
Aligned Student Organization(s):	HOSA: http://www.tennesseehosa.org Amanda Hodges, (615) 532-6270, Amanda.Hodges@tn.gov
Coordinating Work-Based Learning:	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit http://tn.gov/education/cte/work_based_learning.shtml.
Available Student Industry Certifications:	None
Dual Credit or Dual Enrollment Opportunities:	There are available dual credit/dual enrollment opportunities for this course. For more information, reach out to a local postsecondary institution to establish an articulation agreement.
Teacher Endorsement(s):	577, 720
Required Teacher Certifications/Training:	None
Teacher Resources:	http://www.tn.gov/education/cte/HealthScience.shtml

Course Description

Anatomy and Physiology is an upper level course designed to develop an understanding of the structures and functions of the human body, while relating those to knowledge and skills associated

with pathophysiology. Upon completion of this course, proficient students will be able to (1) apply the gross anatomy from earlier courses to a deeper understanding of all body systems, (2) identify the organs and structures of the support and movement systems, (3) relate the structure and function of the communication, control, and integration system, and (4) demonstrate a professional, working understanding of the transportation, respiration, excretory, and reproduction systems. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Biology II, Anatomy and Physiology, and Chemistry II, and Advanced Placement Biology standards.*

Program of Study Application

This is the upper level course in the *Biotechnology Research*, *Diagnostic Services*, *Therapeutic Nursing Services, Emergency Services*, and *Therapeutic Clinical* programs of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Health Science website at http://www.tn.gov/education/cte/HealthScience.shtml.

**Standards marked with the double asterisk (**) serve as extension standards to be taught if course is offered for two credits.

Course Standards

Safety

1) Accurately read, interpret, and demonstrate adherence to safety guidelines appropriate for the roles and responsibilities of employees in healthcare and medical research settings. Listen to safety instructions and be able to explain why certain rules apply. Demonstrate safety techniques and follow all policies and procedures as directed by Occupational Safety and Health Administration (OSHA) guidelines. (TN Reading 2, 3, 4)

Organization of the Human Body

2) Review the definition of anatomy and physiology (A&P) from previous courses, identifying the sections, planes, and regions with associated organs in each. In the review, explain using correct medical terminology why the body is organized into systems and how the cellular building blocks (atoms, molecules, cells, and tissue) work together to form each of the organs. (TN Reading 2, 4, 5; TN Writing 4, 9; TN Biology II 1)

3) Examine the structures, components, and functions of a typical cell, and explain their actions in movement across cell membranes such as diffusion, osmosis, filtration, active transport, endocytosis, exocytosis, phagocytosis, and pinocytosis. Predict abnormalities that can occur with disorders of cell structures from professional journals or textbooks. (TN Reading 1, 3, 4, 9; TN Writing 9; TN Biology II 1; AP Biology E.U. 2, 3.A)

4) Discuss in an oral, written, or digital format the inorganic and organic compounds that are found in living organisms. Describe the consequences if there is a disturbance in any of the following: acid-base balance, change in oxygen and/or carbon dioxide levels, water balance, electrolytes, carbohydrates, lipids, and proteins. (TN Reading 1, 2, 4, 9; TN Writing 4; TN Biology II 3)

5) **Synthesize in a written, oral, or verbal presentation the composition and actions of deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and adenosine triphosphate (ATP). Determine how DNA is involved in the genetic code, and describe the importance of chromosomes, the function of RNA as a messenger, and the role of ATP in energy transfer. (TN Reading 1, 2, 8; TN Writing 2, 4, 9; TN Biology II 3, 4; AP Biology E.U. 3.A)

6) **Define the following terms and formulate a hypothesis related to their chromosome aberration abnormalities: polyploidy, tetraploidy, autosomal aneuploidy, sex chromosome aneuploidy, and abnormalities of chromosome structure. (TN Reading 4; TN Biology II 4; AP Biology E.U. 3.A)

7) Explain how organisms use positive and negative feedback mechanisms to maintain their internal environment and respond to external environmental changes. Identify possible consequences that can occur if the body does not maintain homeostasis. Summarize how cellular metabolism can affect the body's homeostatic state. (TN Writing 2, 9; TN Writing 4; TN Biology II 5; AP Biology E.U. 2.B)

Support and Movement

8) Create a model with a written, digital, or verbal explanation of the three layers of skin (epidermis, dermis, and subcutaneous). Summarize functions and characteristics of each layer; describe layers within epidermis and dermis; outline and sketch cell types and definitions, appendages, blood supply, innervation, and possible lesions. (TN Reading 2, 4, 7; TN Writing 4, 9; TN Biology II 1)

9) Investigate and obtain information on a skin disorder/disease/syndrome from a medical/healthcare journal or textbook. Appraise a sample case study involving review of the A&P of the cells and tissues affected. Decide whether an inflammatory response was involved, identify the causative agent, locate signs and symptoms of the disorder, and relate to normal A&P. (TN Reading 1, 2, 4; TN Writing 4, 9; TN Biology II 1)

10) Synthesize information from textbooks or other biological resources on the elements of bone tissue, including bone cells (osteoblasts, osteocytes, osteoclasts), bone matrix (collagen fibers, proteoglycans, cone morphogenic proteins), and glycoproteins (sialoprotein, osteocalcin, calcium, phosphate, alpha-glycoprotein) with the functions of each. Identify bone minerals and determine how they can change these elements during bone development. (TN Reading 1, 2, 4; TN Writing 4, 9; TN Biology II 1)

11) Provide an accurate summary of the chief characteristics of bones, drawing on textbooks, digital resources, and observations. Examine a model (live, virtual, or graphic) of a bone. Describe how the body maintains bone integrity through remodeling and repair. (TN Reading 4, 5; TN Biology II 1)

12) Explain the structure and function of joints in the body by distinguishing among the three classifications (synarthrosis, amphiarthrosis, diarthrosis). Detail the bones involved in each joint, supply examples, and summarize the methods by which joints assist in movement. In addition, be able to locate and describe joint-related structures such as tendons, ligaments, bursae, and cartilage. Summarize what happens to joints when cartilage erodes. (TN Reading 1, 4; TN Writing 2, 9)

13) Label on a skeleton the names of the bones for each of the following, identifying points of attachment:
    a. Skull 22 bones (cranium 8, facial 14)
    b. Spinal Column/Vertebra 24 with explanation of three parts of a typical vertebra (body, foramen, and processes)
    c. Thoracic Cavity
    d. Upper extremities: Shoulder girdle, arms, wrist, and hands including long bone processes, and three parts of each finger
    e. Lower extremities: hip girdle, legs, ankles, and feet including long bone parts, and parts of toes

    (TN Reading 1)

14) Classify the three categories of muscle fibers, differentiating between cells and tissue. Draw evidence from informational texts to explain the locations, behavioral properties, and functional roles unique to each category. Draw on knowledge of biological processes, such as the body's conversion of ATP into energy, to illustrate phenomena such as muscle fatigue. (TN Reading 2, 4; TN Writing 4, 9; TN Biology II 1)

15) **Differentiate between the characteristics of white muscle and red muscle fibers, including their relationship to fast-twitch and slow-twitch fibers. Debate in class or in a written or digital format the purpose of these two types of muscle fibers as related to muscle strength, power and endurance for fitness/athletic training, and rehabilitation of muscle. (TN Reading 2, 4; TN Writing 1, 6, 7)

16) **Describe the motor unit of the skeletal muscle. Explain how the motor neuron within that motor unit communicates with the muscle cells, how muscle contraction is influenced by protein filaments and the physiological principle of the all-or-none law. (TN Reading 2, 4; TN Writing 4; TN Biology II 6)

17) Explain the guidelines used in naming skeletal muscles, such as location, size, direction, etc. Develop a graphic that identifies the name of the muscle, the directional motion, location, and function of the following muscle groups:
    a. Muscles of facial expressions
    b. Muscles of mastication
    c. Muscles of the neck
    d. Muscles of the trunk and upper extremities
    e. Muscles of lower extremities

    (TN Reading 2, 4, 6)

18) **In an informational essay drawing on multiple peer-reviewed articles, explain the connection between the muscular and skeletal systems, particularly as it concerns posture and movement. Demonstrate knowledge of each independent system by comparing and contrasting roles and functions, while describing the symbiosis between them. (TN Reading 1, 2, 4; TN Writing 2, 4, 9)
19) **Research alterations of musculoskeletal function in the areas of skeletal trauma, support structure injuries, metabolic bone diseases, infectious bone diseases, bone tumors, joint disorders, muscle membrane abnormalities, metabolic muscle disease, inflammatory muscle diseases, and/or muscle tumors. Using correct medical terminology, explain in a written, digital, or oral format the following aspects as they relate specifically to musculoskeletal function:

abnormal anatomy and/or physiology, pathophysiology, underlying causation, clinical manifestations, evaluation, and treatment. Differentiate between the diseases in a pediatric, adult, and elderly person. (TN Reading 1, 2, 4, 8; TN Writing 1, 6, 9)

Communication, Control and Integration

20) Differentiate between the central nervous system and the peripheral nervous system, detailing the anatomy of each system, important functions, differences between afferent, efferent, and associative neurons, and the different categories of nervous cells and tissue. (TN Reading 1, 4; TN Writing 2, 9, TN Biology II 1)

21) Explain the process of action potentials of the nervous system and name the factors that affect the speed at which a nerve impulse travels. Include in the explanation the all-or-none law and substances that can change the transmission such as amino acids, monoamines, acetylcholine, etc. (TN Reading 2, 9; TN Writing 4, 9; TN Biology II 6)

22) Describe the location, structures, and primary functions of the anatomical parts of the central nervous system. Explain the importance of cerebral spinal fluid and its connection to circulation, the phenomenon of the blood-brain barrier within the brain, and white and gray matter in the brain. (TN Reading 2, 4; TN Writing 4, 9)

23) Describe the location, structures, and primary functions of the anatomical parts of the peripheral nervous system (PNS). Differentiate between the structures and functions of the cranial nerves, spinal nerves, sympathetic nerves, and parasympathetic nerves. Determine how the phenomenon of biofeedback relates to the structures of the PNS. (TN Reading 2, 4; TN Writing 4, 8)

24) **Gather relevant information from multiple resources related to how the action of catecholamine will vary with different types of neuroreceptor stimulation. Identify the actions of the autonomic nervous system neuroreceptors, the effector organ or tissue, the adrenergic effect, and the cholinergic effect. Link this information to the processes of vasoconstriction and vasodilation in an informational artifact. (TN Reading 2, 4, 9; TN Writing 4, 8, 9)

25) **Complete a literature review of at least three peer-reviewed articles to summarize the research surrounding theories of pain, especially concerning the neuroanatomy of pain, the concept of pain threshold, and pain tolerance. Include a discussion on the perception of pain in pediatric, the aged, males, and females. Cite the information obtained in an informational essay to share with a focus on addressing the perception with someone in the medical community, using appropriate medical terminology. (TN Reading 1, 2, 4, 6; TN Writing 2, 4, 5, 7, 8)

26) Gather information concerning the sensory system. Synthesize the information surrounding the structure and function of the eye, ear, nose, and mouth. Explain the processes of vision, hearing, smell, and taste. Conduct a short research project to give details on how these systems are influenced by the nervous system or the muscular system. (TN Reading 1, 2, 8, 9; TN Writing 4, 7)

27) Define key terms associated with vision disorders, ear disorders, nose disorders, and mouth disorders. Write a case study based on one of these disorders using appropriate medical

terminology, describing the typical profile of a person suffering from the selected disorder. (TN Reading 1, 2, 4, 8, 9; TN Writing 2, 9)

28) **Research from medical resources the alterations in function of the eyes, ears, nose, and throat. In a written, digital, or oral format, explain the following using correct medical terminology: a) abnormal anatomy and/or physiology, b) pathophysiology, c) underlying causation, d) clinical manifestations, e) evaluation, and f) treatment. Differentiate between the diseases in an infant, pediatric, adult, and elderly person. (TN Reading 1, 2, 4, 8; TN Writing 2, 8, 9)

29) List the structures of the endocrine system, explain the functions of each, describe the hormones related to each structure, and summarize the positive and negative effects on the body. Debate in a written or oral format the effects of human growth hormone use in athletes. (TN Reading 1, 2, 6, 9; TN Writing 1, 4, 9)

30) **Research information to explain the pathophysiology and abnormal anatomy and/or physiology surrounding the hypo- and hyper-secretion of hormones of the endocrine system. Explain how these abnormalities can affect one's physical and mental health. Describe how these diseases manifest themselves in different ways in pediatric, adult, and elderly persons. Develop a public service announcement, community awareness presentation, or health education presentation to inform a selected audience about one of these diseases or disorders, following National HOSA competitive events guidelines. (TN Reading 2, 7, 8; TN Writing 4, 6, 7, 9)

Transportation and Defense

31) Identify the liquid and cellular components of blood using appropriate medical terminology. Summarize the structural characteristics, normal levels, function, and life span of each. Evaluate the information to explain how and where each component is manufactured (i.e., as with hematopoiesis and erythropoiesis) and what happens if there are complications with the development. (TN Reading 1, 4, 9; TN Writing 9; TN Biology II 1)

32) **Define hemostasis and explain the related mechanisms that involve the vasculature, platelets, and blood proteins. Relate how clotting factors assist with hemostasis, and describe the complications that arise if there is an abnormality with one of these factors. (TN Reading 1, 2, 5; TN Writing 4)

33) Illustrate in a digital or 3D format the process of inflammation that occurs when tissue has been damaged in the body. Synthesize the inflammatory response process within the circulatory system using medical terminology, then translate information into a brochure that can be provided to a pediatric or geriatric patient. Use phrases and explanations that can be easily understood by each group. (TN Reading 2, 4, 7, 9; TN Writing 6)

34) Describe the roles of antigens and antibodies in the blood while explaining the ABO system and Rh classification system. In a lab setting with simulated blood, determine the ABO and Rh with an explanation of results written in a scientific method format. (TN Reading 2, 3, 4, 8; TN Writing 4, 6)

35) Outline the structure and functions of the anatomy of the cardiovascular system, paying special attention to the musculature of the walls, the chambers, and the valves of the heart and blood vessels. Locate and demonstrate the circulation of blood through the heart; describe the phases and importance of the cardiac cycle and how heart rate and cardiac output relate to one another. Listen to heart sounds, either digitally or with a stethoscope, to identify the normal and abnormal sounds made during the cardiac cycle. Explain the causes for abnormal sounds encountered. (TN Reading 2, 3, 4, 5; TN Writing 2, 4, 9)

36) **Differentiate among the systemic, coronary, hepatic portal, pulmonary, cerebral, and fetal circulation systems, formulating an original hypothesis on possible changes in physiology and pathology in response to new environments and/or stimuli. (TN Reading 2, 8; TN Writing 8, 9)

37) **Describe each part of the conduction system of the heart and its related function. Interpret an electrocardiograph (ECG) of a normal sinus rhythm, identifying the P, Q, R, S, and T waves with an explanation of the electrical and mechanical event of each. Identify ECG strips with explanation of sinus, junctional, and ventricular arrhythmias. (TN Reading 1, 2, 4, 9; TN Writing 4)

38) **Develop an informational fact sheet on diseases of the cardiovascular system. Include in the fact sheet the definition of the disease, the signs and symptoms, diagnostic procedures, underlying causation, clinical manifestations, evaluation, and treatment. (TN Reading 2, 4, 6; TN Writing 4, 5)

39) Describe in a written, oral, or digital format the structure and function of the lymphatic system, lymphatic vessels, and lymph nodes. Differentiate between the cells of the immune response and other defenses, and explain how they work with antigens, antibodies, and individual immunity to maintain homeostasis in the body. (TN Reading 2, 4; TN Writing 4, 9)

40) **Explain from research in peer-reviewed professional journals and/or textbooks the effects of aging on the lymphatic and immune systems, including discussion of the diseases or disorders that can occur. (TN Reading 1, 2, 8, 9; TN Writing 4, 7)

41) **Investigate and explain, citing evidence from textbooks, professional journals, and/or websites, the mechanisms surrounding allergic response, autoimmune, and alloimmune diseases. Explain what systems are involved in the responses and any preventive measures that can be initiated. (TN Reading 1, 2, 4, 8; TN Writing 2, 4, 9)

Respiration, Nutrition, and Excretion

42) Review case studies that involve persons with respiratory disorders, diseases, or syndromes. Citing information from the review, explain the expected anatomy involved and what abnormality is present; and outline normal and abnormal physiology, pathophysiology, preventive measures, and diagnostic procedures for identification of the disease/disorder. (TN Reading 1, 2, 6, 8, 9; TN Writing 2, 4, 9)

43) Define Boyle's Law and the relationship of ventilation, external respiration, internal respiration, and the overall process of gas exchange in the lungs and tissue. Correlate the neural and chemical factors in the control of inspiration and expiration. Identify normal and abnormal lung sounds, explaining the structures responsible for the sounds. (TN Reading 1, 2, 4; TN Writing 4)

44) Trace food from the time it enters the body until it is released, outlining the organs involved and the digestive processes that occur. (TN Reading 1, 2, 4, 5)

45) **Compare and contrast Basal Metabolic Rate (BMR) and Basal Metabolic Index (BMI). Calculate the BMR and BMI for multiple weights and explain the significance of BMI measurement on the health of individuals. Develop a meal plan for someone who has a BMI greater than 24.5 in order to reduce risk of diabetes, heart disease, or stroke. (TN Reading 2, 4, 9; TN Writing 4, 8)

46) **Research medical texts and peer-reviewed journals to explain the pathophysiology and abnormal anatomy and/or physiology surrounding diseases, disorders, and/or syndromes of the digestive system. Explain how these abnormalities can affect one's physical health, outlining signs and symptoms, underlying causation, clinical manifestations, diagnostic procedures, evaluation, and treatment. Differentiate between the diseases in a pediatric, adult, and elderly person. Develop a public service announcement, community awareness presentation, or health education presentation to inform a selected audience about one of these diseases or disorders using the National HOSA competitive events guidelines. (TN Reading 1, 2, 4, 6, 8; TN Writing 2, 4, 6)

47) Design a concept map of the structures of the urinary system, complete with associated explanations of the functions of each structure. Predict possible complications for each structure and outline methods to prevent the complications. (TN Reading 2, 4; TN Writing 4, 9)

48) Identify the internal and external anatomy of the kidney. Analyze the blood supply that is required for functioning, the physiology of the nephrons, the process by which urine is formed, the pathways for excretion in males and females, and the chemical and nervous system control of urinary secretion. (TN Reading 2, 4, 5)

49) **Investigate how the urinary system interacts with other body systems. Provide descriptions of the anatomy and physiology involved and possible complications that might arise with an imbalance. (TN Reading 2, 4, 5)

50) **Research the pathophysiology and abnormal anatomy and/or physiology surrounding diseases, disorders, and/or syndromes of the urinary system. Explain how these abnormalities can affect one's physical health, outlining signs and symptoms, underlying causation, clinical manifestations, diagnostic procedures, evaluation, and treatment. Differentiate between the diseases in a pediatric, adult, and elderly person. (TN Reading 1, 7, 8, 9; TN Writing 4, 8, 9)

Reproduction, Growth, and Development

51) Outline the structure and function of the male reproductive system. Include information about the anatomy of the spermatozoa, the ducts of the system, accessory glands, and semen. (TN Reading 1, 2, 4; TN Biology II 6)

52) Summarize in a written, verbal, or digital format the structure and function of the female reproductive system, and the hormones that affect the multiple stages of the menstrual cycle. (TN Reading 1, 2, 4; TN Writing 4, 6; TN Biology II 6)

53) Evaluate and provide evidence of the process of fertilization, mitosis, and meiosis, then outline the timeline and phases of development of a fetus, from fertilization until birth. Describe the abnormalities that can occur at each phase, including genetic disorders and other congenital complications. (TN Reading 1, 2, 4; TN Writing 4, 8; TN Biology II 4, 5, 6)

54) **Research and develop a public service announcement or public health presentation to inform high school students and young adults of the various types of sexually transmitted diseases. Provide informative and factual details concerning complications, signs and symptoms, preventive measures, and treatments available for diseases discussed. (TN Reading 1, 2, 9; TN Writing 4, 6, 9)

Standards Alignment Notes

*References to other standards include:

- TN Reading: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 11-12 Students (page 62).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects; Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 11-12 Students (pages 64-66).
    - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Biology II: Tennessee Science: Biology II standards may provide additional insight and activities for educators.
- TN Chemistry II: Tennessee Science: Chemistry II standards may provide additional insight and activities for educators.
- TN A&P: Tennessee Science: Anatomy and Physiology standards may provide additional insight and activities for educators.
- AP Biology: Advanced Placement Biology standards may provide additional insight and activities for educators.
- P21: Partnership for 21st Century Skills Framework for 21st Century Learning
    - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.